

Parasitic Helminths from Paraguay IV:
Cosmocercoid Nematodes from
Phyllomedusa hypochondrialis (Daudin)
(Amphibia: Hylidae)

by

Michael R. BAKER * and Claude VAUCHER **

With 3 figures

ABSTRACT

Three nematode species (Cosmocercoida; Cosmocercinae) were recovered from *Phyllomedusa hypochondrialis* (Daudin) in Paraguay. *Cosmocercella minor* (Freitas & Dobbin, 1961) is redescribed, and descriptions of *Cosmocercella phyllomedusae* n. sp. and *Neocosmocercella paraguayensis* n. gen., n. sp. are given. *C. phyllomedusae* is distinguished by the presence of rosette caudal papillae in addition to four unpaired vesiculated papillae in males. The monospecific genus *Neocosmocercella* is distinguished from other genera by the presence of three bilobed lips, hexagonal mouth opening, and a modified female reproductive system (vagina greatly elongated, uterine sac present, uteri prodelphic). All three species are apparently restricted to *P. hypochondrialis*.

INTRODUCTION

During the recent collecting trip of the Museum of Geneva to Paraguay¹ a substantial number of frogs was examined for helminth parasites (see VAUCHER 1980). In the present study we consider three cosmocercoid nematode parasites collected from a single frog species, *Phyllomedusa hypochondrialis*.

¹ Autumn 1979, participants: F. Baud, V. Mahnert, J.-L. Perret and C. Vaucher, Geneva; C. Dlouhy, Asunción.

* Department of Zoology, University of Guelph, Guelph, Ontario, Canada N1G 2W1.

** Muséum d'histoire naturelle, case postale 434, CH-1211 Genève 6, Suisse.

I. DESCRIPTION OF SPECIES

Cosmocercella Steiner, 1924*Cosmocercella minor* (Freitas & Dobbin, 1961)

Material Examined: 4 positive hosts out of 10, No. MHNG 979.532-535. In 3 cases, coparasites with *C. phyllomedusae* n. sp. and in one case with *C. phyllomedusae* and *Neocosmocercella paraguayensis* n. sp.

Host: *Phyllomedusa hypochondrialis* (Daudin).

Localities: 972.532, 533: San Lorenzo/Asunción, 6.10.1979; 979.534: Colonia Sgto Jose E. Lopez (Concepcion prov.), 13.10.1979; 979.535: Capitan Bado (Amambay prov.), 25.10.1979.

DESCRIPTION (Fig. 1)

Cosmocercinae. Oral opening triangular, three lips present, each with thin anteriorly projecting cuticular flange. Cephalic extremity with four large papillae. Anterior extremity of oesophagus with three tooth-like projections covered with thick cuticle. Lateral alae extending from just behind head to near anus in both sexes. Somatic papillae numerous.

Male (5 specimens): Total length 0,975-1,23 mm. Length of oesophagus 261-309 μm (pharyngeal portion 20-23 μm , corpus 168-203 μm , isthmus 19-30 μm , bulb 48-56 μm). Nerve ring 90-119 μm and excretory pore 174-212 μm from anterior extremity. Maximum width of lateral alae 2.5 μm . Tail 116-126 μm long, conical, with 20-22 papillae variable in distribution and indistinguishable in size and morphology from somatic papillae; 5-6 papillae lateral or subdorsal in position, 14-16 papillae in two closely spaced sublateral rows in midregion of tail. Caudal alae present on sublateral surface of body, extending 30 μm posterior to and 40 μm anterior to anus; each ala containing four or five small papillae. Anterior lip of anus with two pairs and one large unpaired papilla. Posterior lip of anus with fine comb-like cuticular fringe. Preanal subventral surface with four pairs of large vesiculated papillae. Preanal subventral musculature inconspicuous. Spicules 80-97 μm long, gubernaculum 21-25 μm long, weakly sclerotized.

Female (5 specimens): Total length 1,29-1,38 mm. Length of oesophagus 331-352 μm (pharyngeal portion 22-27 μm , corpus 218-231 μm , isthmus 21-39 μm , bulb 58-63 μm). Nerve ring 131-154 μm , excretory pore 221-242 μm and vulva 770-850 μm from anterior extremity. Maximum width of lateral alae 5 μm . Tail 137-144 μm long, conical. Vagina directed anteriorly in proximal half, flexed to posterior in distal half. Uteri short; ovary of anterior uterus located anterior to vulva, ovary of posterior uterus located beside vulva. Up to three eggs observed in uteri of individual females. Eggs large, 143-155 μm long and 72-89 μm wide (based on eight specimens). Occasionally eggs containing fully developed larva; free larvae not observed *in utero*.

DISCUSSION

C. minor was originally described from *Phyllomedusa hypochondrialis* of Camaragibe, Estado de Pernambuco, Brazil. Its report herein in the same host from Paraguay extends the known range by about 1200 km.

Our specimens of *C. minor* closely resemble the original description by FREITAS & DOBBIN (1961) except in the following. First, the spicules are slightly shorter (105-126 μm long for the specimens from Brazil, 80-97 μm for those from Paraguay). This difference cannot be considered to be significant, however. Second, FREITAS & DOBBIN (1961) described the presence of thin postanal caudal alae containing numerous small ventral postanal papillae. In our specimens, the body cuticle around these closely spaced papillae is slightly thickened, but we do not interpret this as true alae. Thirdly, FREITAS

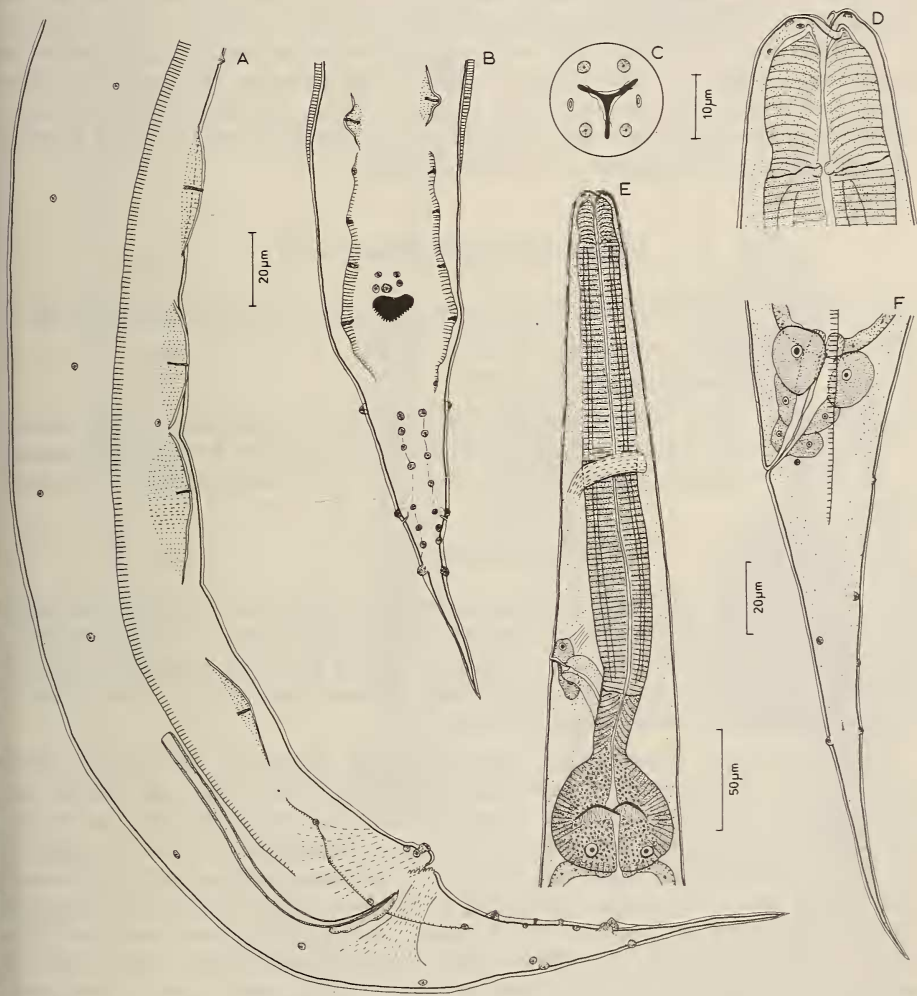


FIG. 1.

Cosmocercella minor (Freitas & Dobbin, 1961) Baker & Adamson, 1977. A, B, caudal end of male, lateral and ventral view. C, D, cephalic extremity, apical and lateral view. E, anterior end of female, lateral view. F, tail of female, lateral view.

& DOBBIN made no mention of the presence of subventral adanal caudal alae which in our specimens contain several small papillae. These structures, however, are easily overlooked.

The redescription of male caudal structures of *C. minor* permits us to show that this species is closely related to *C. haberi* (Steiner) (type species of the genus) and *C. anothecae* (Baker & Adamson), both from North American hylid frogs (see BAKER & ADAMSON 1977). All three of these species have four pairs of preanal vesiculated papillae and a number of papillae associated with caudal alae. Caudal alae are rare in the *Cosmocercinae*; they occur in no other *Cosmocercella* species. *C. minor* is easily distinguished from *C. haberi* and *C. anothecae* in that it has shorter pedunculate papillae within smaller caudal alae, and the vesiculated papillae are surface swellings of the body cuticle, whereas in *C. haberi* and *C. anothecae* they are large oval structures deeply embedded in the hypodermis. *C. minor* is clearly more specialized than the other two species for these caudal features. This indicates a possible origin for North American species of *Cosmocercella* from more primitive South American species. The hylid frogs of North America are relatively recent immigrants from South America.

Cosmocercella phyllomedusae n. sp.

Type Material: MHNG 979.536. Coparasite with *Neocosmocercella paraguayensis* n. sp.

Host: *Phyllomedusa hypochondrialis* (Daudin).

Locality: San Lorenzo/Asunción, 6.10.1979.

Other Material: 979.537: San Lorenzo/Asunción, 6.10.1979 (coparasite with *C. minor*);

979.538: Colonia Sgto Jose E. Lopez, 13.10.1979; (coparasite with *N. paraguayensis* n. sp. and *C. minor*); 979.539: Capitan Bado, 25.10.1979 (coparasite with *C. minor*).

DESCRIPTION (Fig. 2)

Cosmocercinae. Oral opening triangular, three lips present, each with thin anteriorly projecting cuticular flange. Cephalic extremity with four large papillae. Anterior extremity of oesophagus with three tooth-like projections covered with thick cuticle. Lateral alae conspicuous, extending from just behind head to near anus in both sexes. Somatic papillae numerous in males, absent in females.

Male (holotype): Total length 1.18 mm. Length of oesophagus 374 μm (pharyngeal portion 26 μm , corpus 255 μm , isthmus 23 μm , bulb 70 μm). Nerve ring 190 μm and excretory pore 275 μm from anterior extremity. Maximum width of lateral alae 30 μm . Tail 215 μm long, tapering abruptly in anterior third, elongate and slender in posterior two-thirds. Posterior third of tail with two pairs of subventral and two pairs of subdorsal papillae and pair of phasmids. Mid-region of tail with pair of prominent subventral papillae surrounded by raised rosette of bosses. Anterior lip of anus with one large unpaired and one large pair of papillae. Subventral and lateral adanal surface with six papillae, two of which are double. Preanal subventral surface with numerous irregularly distributed papillae: six pairs of small rosette papillae extending up to 150 μm anterior to anus; eight pairs of rosette papillae surrounded by wide areas of cuticular punctuations and extending from 150 μm anterior to anus to 450 μm anterior to anus; four large unpaired vesiculated papillae extending from 450 μm anterior to anus to near level of oesophagus. Subdorsal surface of body with numerous small somatic papillae. Preanal

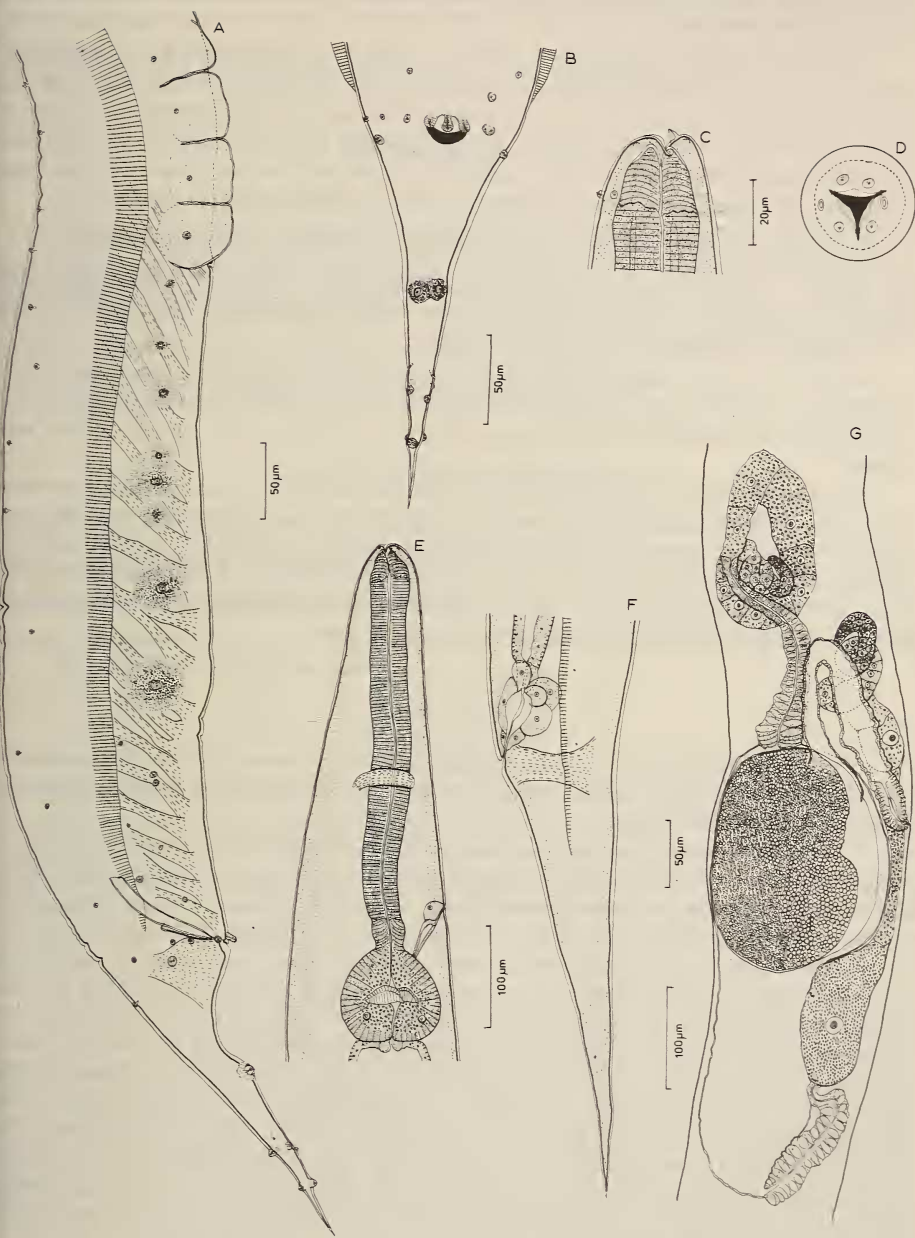


Fig. 2.

Cosmocercella phyllomedusae n. sp. A, B, caudal end of male, lateral and ventral view. C, D, cephalic extremity, lateral and apical view. E, anterior end of female, lateral view. F, tail of female, lateral view. G, female reproductive system, lateral view.

subventral side of body with 20 pairs of conspicuous muscle cells extending from anus to vesiculated papillae. Spicules 80 μm long, sharply pointed; gubernaculum 36 μm long, weakly sclerotized.

Female (allotype): Total length 2.19 mm. Length of oesophagus 490 μm (pharyngeal portion 36 μm , corpus 339 μm , isthmus 26 μm , bulb 89 μm). Nerve ring 230 μm , excretory pore 368 μm and vulva 1.12 mm from anterior extremity. Maximum width of lateral alae 20 μm . Tail 360 μm long, conical. Vagina directed anteriorly in proximal half, flexed posteriorly in distal half; *vagina vera* 50 μm long, *vagina uterina* 275 μm long. Uteri short. Both ovaries located anterior to vulva. One large egg in uterus.

Paratypes: Measurements of three males and four females are as follows:

Males — total length 1.19-1.87 mm; oesophagus 370-388 μm long; nerve ring 162-181 μm , excretory pore 259-275 μm from anterior extremity; spicules 70-78 μm , gubernaculum 37-40 μm , tail 223-240 μm long.

Females — total length 2.05-2.34 mm; oesophagus 449-485 μm long; nerve ring 149-209 μm , excretory pore 302-366 μm and vulva 1.06-1.22 mm from anterior extremity; tail 340-365 μm long, eggs 205-220 μm long and 125-170 μm wide (based on five specimens).

Males were similar to the holotype in the disposition of the caudal papillae, however, there were slight variations in the number of simple subventral papillae near the anus and the number of preanal rosette papillae and papillae surrounded by wide areas of punctations. None of the more than fifty female worms examined contained more than three embryos in the uteri. Most embryos observed were contained within an egg-shell, although occasionally freed larvae were observed *in utero*.

DISCUSSION

C. phyllomedusae n. sp. is unique amongst species of *Cosmocercella* in the possession of markedly large rosette caudal papillae in addition to four large unpaired adjacent vesiculated papillae in males.

The classification of *C. phyllomedusae* presents difficulties because it has a mix of morphological traits which are characteristic of two genera in the Cosmocercinae. Thus rosette caudal papillae in males normally occur only in *Cosmocercoides* and vesiculated caudal papillae are characteristic only of *Cosmocercella*. However, the rosette papillae in *C. phyllomedusae* are morphologically quite different from those seen in species of *Cosmocercoides* (a morphologically homogeneous group) and the vesiculated papillae are unpaired and adjacent, whereas in other species of *Cosmocercella* they are paired and spaced apart. It is possible that neither the rosettes nor the vesiculated papillae in *C. phyllomedusae* are homologous with corresponding structures in the genera *Cosmocercella* and *Cosmocercoides*. We prefer to classify *C. phyllomedusae* in *Cosmocercella* for the following reasons. First, this species is a coparasite with *Cosmocercella minor* in the frog *Phyllomedusa hypochondrialis*. Although they differ considerably in morphology, it is likely that these two species are phylogenetically closely related. *C. minor* has already been shown to be closely related to the type species of *Cosmocercella*. Second, the reduced number and relatively large size of the eggs *in utero* of *C. phyllomedusae* is similar to other *Cosmocercella* species, whereas *Cosmocercoides* species are larger in size and contain numerous small eggs *in utero*.

The occasional presence of freed larvae in the uteri of *C. phyllomedusae* indicates a tendency towards viviparity in this species. Viviparity is the key characteristic distin-

guishing the closely related Family Atractidae from the oviparous Cosmocercidae (see BAKER 1982). However, *C. phyllomedusae* is mainly oviparous and apparently eggs only rarely hatch *in utero* before being expelled. In contrast, in the Atractidae freed larvae are usually retained *in utero* until they develop to the third larval stage. There is no evidence that this specialized biology occurs in *C. phyllomedusae*.

Neocosmocercella n. gen.

Diagnosis: Cosmocercioidea, Cosmocercidae, Cosmocercinae. Cephalic end with three bilobed lips; each lobe bearing anteriorly directed cuticular flange. Mouth hexagonal, cheilostome triradiate. Vagina elongate (> 1.5 mm), large common uterine sac present, didelphic, uteri anteriorly directed, both ovaries anterior to vulva. Eggs large (> 150 μ m long). Caudal end of male with large vesiculated papillae. Posterior half of male body coiled sinistrally, anterior half straight; female body straight.

Type Species: *Neocosmocercella paraguayensis* n. sp.

Neocosmocercella paraguayensis n. sp.

Type Material: MHNG 979.540. Coparasite with *C. phyllomedusae*.

Host: *Phyllomedusa hypochondrialis* (Daudin).

Locality: San Lorenzo/Asunción, 6.10.1979.

Other material: 979.541: Colonia Sgto Jose E. Lopez, 13.10.1979 (coparasite with *C. minor* and *C. phyllomedusae*).

DESCRIPTION (Fig. 3)

Cosmocercinae. Oral opening hexagonal, three shallow lips present, each with pair of anteriorly projecting cuticular flanges. Cephalic extremity with four large papillae. Anterior extremity of oesophagus with three tooth-like projections covered with thick cuticle. Lateral alae conspicuous, extending from anterior third of oesophageal corpus to near anus in both sexes. Somatic papillae not observed. Posterior half of male body in tight sinistral coils, female body not coiled. Cuticle of body with conspicuous transverse striations spaced about 2.5 μ m apart in males and 6 μ m apart in females.

Male (holotype): Total length 2.35 mm. Length of oesophagus 298 μ m (pharyngeal portion 35 μ m, corpus 271 μ m, isthmus 30 μ m and bulb 62 μ m). Nerve ring 172 μ m and excretory pore 296 μ m from anterior extremity. Maximum width of lateral alae 6 μ m. Tail 124 μ m long, conical, with three pairs of subventral and two pairs of lateral papillae and a pair of phasmids. Anterior lip of anus with one large unpaired and three pairs of papillae. Preanal region with two pairs of sessile papillae and two rows of vesiculated papillae (12 papillae on right subventral side, 13 on left side). Preanal subventral side of body with 24 pairs of conspicuous muscle cells extending from anus to anterior-most vesiculated papillae. Spicules 132 μ m long, sharply pointed; gubernaculum 43 μ m long.

Female (allotype): Total length 4.3 mm. Length of oesophagus 473 μ m (pharyngeal portion 40 μ m, corpus 328 μ m, isthmus 37 μ m, bulb 68 μ m). Nerve ring 207 μ m, excretory pore 361 μ m and vulva 1.9 mm from anterior extremity. Maximum width of lateral alae 6 μ m. Tail 297 μ m long, conical. Vagina 1.9 mm long, directed anteriorly and cuticle-

lined for $90\ \mu\text{m}$ from vulva (*vagina vera*) and flexed posteriorly in remainder (*vagina uterina*). Vagina opening into large anteriorly directed uterine sac $650\ \mu\text{m}$ long giving rise to two unequal anteriorly directed uteri. Uterine sac containing four embryos; one

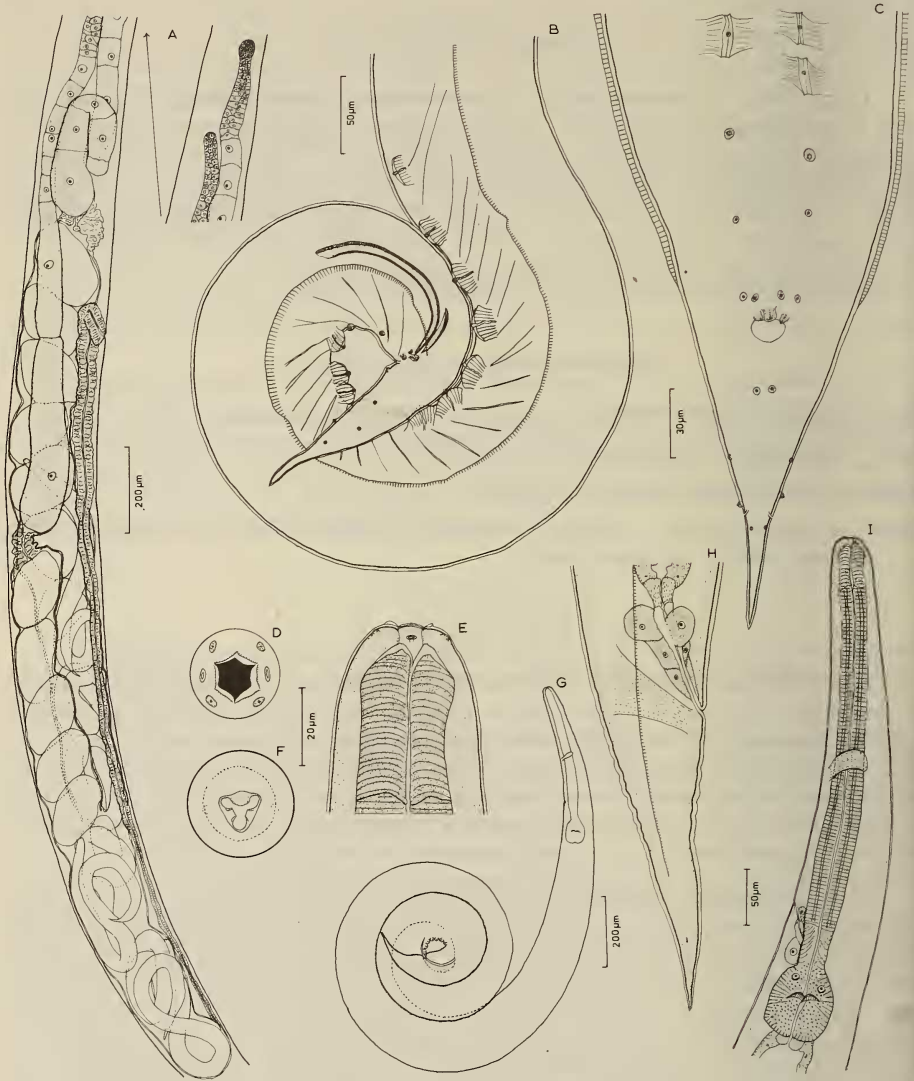


FIG. 3.

Neocosmocercella paraguayensis n. gen., n. sp. A, female reproductive system, lateral view. B, C, caudal end of male, lateral and ventral view. D, E, anterior extremity, apical and lateral view. F, anterior extremity, optical section through base of buccal cavity. G, male, lateral view showing curvature of posterior half of body. H, tail of female, lateral view. I, anterior end of female, lateral view.

uterus 700 μm long (with five embryos) and the other 1.5 mm long (with ten embryos). Some eggs containing fully formed larvae; two larvae free of egg shell observed. Both ovaries located anterior to vulva.

Paratypes: Measurements of five males and four females are as follows:

Males — total length 1.8-3.2 mm; oesophagus 388-444 μm long; nerve ring 163-194 μm , excretory pore 252-333 μm from anterior extremity; spicules 123-153 μm , gubernaculum 34-43 μm , tail 114-162 μm long.

Females — total length 3.2-4.1 mm; oesophagus 416-460 μm long; nerve ring 170-206 μm , excretory pore 302-348 μm and vulva 1.5-1.9 mm from anterior extremity; tail 246-267 μm long; eggs 190-225 μm long and 110-130 μm wide (based on five specimens), containing blastula or gastrula.

Males were similar to the holotype in disposition and number of caudal papillae except for the vesiculated preanal papillae. These varied in number from 19-27. Usually either the left or right side of the body carried from one to three more papillae than the opposite side. In females, most embryos were contained within an egg shell, although a few free larvae were also observed in the uterine sac or uteri.

DISCUSSION

Neocosmocercella n. gen., with a single species, is easily distinguished by a suite of characters not observed in other genera of Cosmocercinae: cephalic lips bilobed, forming a hexagonal mouth opening (lips not bilobed, forming triangular mouth in all other genera); vagina markedly elongate, especially the *vagina uterina* (vagina relatively short in other genera); uterine sac present (absent in other genera); uteri both directed anteriorly (divergent in other genera); posterior half of male body in form of tight sinistral coils) straight or tail slightly curved ventrally in other genera). These characters are taxonomically important and merit recognition at the generic level.

Neocosmocercella is probably most closely related to *Cosmocercella* Steiner. Both have large vesiculated papillae in males which are absent in other genera and *N. paraguayensis* shares the same amphibian host with two species of *Cosmocercella*. The unique distinguishing characters for *Neocosmocercella* mentioned above are all probably specializations which may be derived from the primitive condition observed more generally in the subfamily. Thus although *Neocosmocercella* has a hexagonal mouth, there are nevertheless three lips present and the cheilostome preserves the ancestral triradiate condition. The uterine sac is evidently a neof ormation and the displacement of the uteri into a prodelphic condition is probably related to this development and to the elongation of the vagina.

Several female specimens of *N. paraguayensis* examined had a small number of freed larvae in the uterine sac. There was no evidence, however, that larvae undergo development in this location and therefore this is not comparable to the viviparous biology of the related Family Atractidae.

II. CONCLUSIONS

The occurrence of three cosmocercoid species (including two congeneric species) in the rectum of a single frog species is unusual, but in accordance with numerous similar observations of other nematode parasites in vertebrates (CHABAUD & DURETTE DESSET

1978). It is possible that in the present example there is a partition of host resources to minimize competition. The two *Cosmocercella* species and *N. paraguayensis* all differ in size attained by adult male and female worms and the unique oral structures of *N. paraguayensis* may indicate a difference in feeding habits of this species.

It is also of interest to note that all three nematode species from *P. hypochondrialis* are apparently restricted to this host. 31 other species of Bufonidae, Hylidae, Leptodactylidae, Microhylidae and Pseudidae from Paraguay were examined and none was parasitized by *Cosmocercella* or *Neocosmocercella*.

ACKNOWLEDGEMENTS

The authors are especially indebted to Mr. Hernando Bertoni, the Minister of Agriculture and Livestock and to the Swiss Technical Cooperation for all the facilities they have accorded during the field work in Paraguay.

RÉSUMÉ

Trois espèces de Nématodes (Cosmocercoidea: Cosmocercinae) ont été trouvées chez *Phyllomedusa hypochondrialis* au Paraguay: *Cosmocercella minor* (Freitas & Dobin, 1961), *C. phyllomedusae* n. sp. et *Neocosmocercella paraguayensis* n. gen. n. sp. *C. phyllomedusae* se distingue par la présence de papilles caudales en forme de rosettes en plus de quatre papilles vésiculées impaires chez le ♂. Le genre monospécifique *Neocosmocercella* est caractérisé par sa bouche hexagonale et un système reproducteur femelle modifié (vagin très allongé, présence d'un sac utérin, prodelphie). Ces trois espèces ne se rencontrent apparemment que chez *P. hypochondrialis*.

BIBLIOGRAPHY

- BAKER, M. R. 1982. Systematic relationships of the Atractidae and Cosmocercidae (Nematoda: Cosmocercoidea): two new atractids parasitic in amphibians and fish. *Can. J. Zool.* 60: 2395-2402.
- BAKER, M. R. and M. L. ADAMSON. 1977. The genus *Cosmocercella* Steiner, 1924 (Nematoda: Cosmocercoidea). *Can. J. Zool.* 55: 1644-1649.
- CHABAUD, A. G. and M. C. DURETTE-DESSET. 1978. Parasitisme par plusieurs espèces congénériques. *Bull. Soc. zool. Fr.* 103: 459-464.
- FREITAS, J. F. T. and J. E. DOBBIN. 1961. *Raillietnema minor* sp. n. (Nematoda, Cosmocercidae). *Revta bras. Biol.* 21: 367-371.
- VAUCHER, C. 1980. Mission zoologique du Muséum au Paraguay. *Musées Genève Mars*, 11-17.
-